

Maternal Alcohol Consumption During the Perinatal and Early Parenting Period: A Longitudinal Analysis

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Abstract *Objectives* Despite potential health risks for women and children, one in five women report alcohol use during pregnancy and a significant proportion of those who quit during pregnancy return to drinking post-delivery. This study seeks to understand the longitudinal patterns of alcohol consumption before, during pregnancy and post-delivery, and the role of maternal characteristics for purposes of informing prevention design. *Methods* General growth mixture models were used to describe the average developmental patterns of maternal weekly drinking quantity at six time points, from preconception through child entering kindergarten, as well as heterogeneity in these patterns among 9100 mothers from the Early Childhood Longitudinal Study representing the 2001 US national birth cohort. *Results* Four distinct classes of mothers were defined by their longitudinal alcohol consumption patterns: *Low Probability Drinkers* (50.3 %), *Escalating Risk Drinkers* (12.0 %), *Escalating Low Risk Drinkers* (27.4 %), and *Early Parenting Quitters* (10.2 %). Heterogeneous covariate associations were observed. For example, mothers who gave birth after age 36 were twice as likely to be *Escalating Risk Drinkers* and *Escalating Low Risk Drinkers* (vs *Low Probability Drinkers*), but not more likely to be *Early Parenting Quitters*, when compared to mothers who gave birth between the ages of 26 and 35. *Conclusions for practice* There is significant heterogeneity in maternal

longitudinal alcohol use patterns during the perinatal period. Baseline maternal characteristics and behavior associated with these heterogeneous patterns provide valuable tools to identify potential risky drinkers during this critical time period and may be synthesized to tailor pre- and postnatal clinical counseling protocols.

Keywords GGMM · Maternal drinking · Pregnancy · Alcohol use · ECLS-B

Significance

Alcohol use during pregnancy is a leading cause of poor infant outcomes. Postpartum alcohol consumption potentially poses risk to women's own health and may contribute to a deficient child-rearing environment. Past research has solely focused on either pregnancy or postpartum use with only a single point-in-time measure within one year post-delivery.

This study investigated the longitudinal patterns of weekly quantity of maternal drinking using data from a large national representative sample, covering the entire perinatal period, from pre-conception to five to six years after childbirth. The investigation of how maternal characteristics and behaviors at baseline predict these patterns contributes to early identification and tailored clinical interventions for perinatal and early parenting women at risk of problematic alcohol use.

Introduction

Alcohol use during pregnancy (AUDP) is a leading cause of still birth, spontaneous abortion, preterm delivery, and various child neurobehavioral problems [1]. Despite a

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significant dose-response relationship [2], even low-level AUDP can be detrimental to a child's neurocognitive development [3]. Such risks have inspired a growing body of epidemiological research to examine patterns of use and risk factors for maternal prenatal alcohol consumption [4], and have guided the development of effective prevention programs, such as the Family–Nurse Partnership [5], as well as the implementation of state and federal legislations, such as Title V (Maternal and Child Health Services) of the Social Security Block Grants [6].

Despite the significant decline in drinking during pregnancy (from 58 to 19 % in the first trimester, further to 6 % in the third trimester), 37–52 % new mothers resume alcohol consumption within a year post-delivery [7–9]. In addition to the well-documented harmful effects of risky drinking (defined as consuming 4 + drinks per occasion or 7 + drinks per week) on mothers' own health [10], exposure to alcohol through breast milk can also pose significant risks to a child's well-being [11]. In addition, excessive alcohol consumption postnatal, often accompanied by maternal distraction, neglect, unpredictable behavior, and other mental health issues, contributes to a deficient child rearing environment [12]. While it is recognized that risky maternal drinking can be identified during pediatric visits [13], prevention efforts implemented immediately after delivery have been found to be of limited effectiveness [14] or to have only short-term benefits [15]. Compared to data on mothers' prenatal alcohol consumption, there are limited epidemiological data on alcohol use during the postpartum and early parenting periods to guide intervention efforts.

There are inherent challenges to understanding maternal drinking around the time of childbirth reflecting each woman's unique contextual milieu. On one hand, pregnancy and childbirth mark an important transition in women's lives characterized by psychosocial, economic and logistical changes [16], which may facilitate reduced alcohol consumption through changing norms, expectations, and responsibilities [17, 18]. On the other hand, increased responsibilities associated with caring for a young child may create stressful challenges, undermining the parenthood's potential protective effect on drinking [19]. Both intra- and interindividual developments inform a longitudinal process that may be expressed as a maternal perinatal drinking pattern. However, to date, studies of maternal drinking behavior have examined prenatal [20–23] and postnatal [7, 24–27] drinking separately, with most postpartum studies measuring it at a single point in time within 1 year post-delivery.

This study is the first to systematically investigate the longitudinal patterns of weekly maternal drinking quantity using data from a large nationally representative sample, covering the entire perinatal period from pre-conception until five to 6 years after childbirth. We hypothesized that mothers in this sample tend to follow several distinct

trajectories of alcohol drinking during perinatal period, e.g., a low drinking trajectory, a persistent and high drinking trajectory, and a moderate drinking trajectory. To contribute to the research on early identification of at-risk mothers, we further investigate how maternal characteristics and behaviors measured at baseline predict these patterns. We hypothesized that several of these characteristics may be related to the likelihood of following each trajectory. For example, older women and those with higher income may be less likely to follow a low drinking trajectory compared to their younger and less wealthy peers.

Methods

Sample

Data are drawn from the Early Childhood Longitudinal Study (ECLS-B) conducted by the US Department of Education–National Center for Education Statistics (NCES). ECLS-B is a prospective longitudinal data set with a nationally representative sample of 10,700 children from the 2001 US birth cohort followed from birth through kindergarten. This study employs survey data collected from adult biological mothers interviewed when a child was 9 months old (baseline survey), and then followed up when the child was 2 years old (2003–2004), 4 years old (2005–2006, preschool), and again 5 or 6 years old (2006–2007, kindergarten). Detailed information, including sampling design and survey instruments are available elsewhere [28, 29].

Mothers were asked at each of the four interviews whether they drank any alcohol. Information regarding third trimester AUDP was retrospectively collected at the baseline interview, circumventing the potential underreporting of antenatal reports during pregnancy [30–32]. In addition, mothers were asked at baseline to report their alcohol consumption 3 months prior to conception, resulting in a total of 6 time points for alcohol consumption measures. We excluded mothers with missing alcohol consumption data at all six time points (1 % of the sample). The remaining missing data on drinking measures (about 60 % had valid information on all six drinking measures and another 20 % missed only one drinking measure) were accounted for by using the widely accepted full information maximum likelihood (FIML) estimation method [33, 34]. We further excluded cases with missing data on any of the exogenous variables (about 10 % of the sample) resulting in an analytical sample of 9100 (sample size rounded to the nearest 50 in compliance with the ECLS-B confidentiality rules [29]). Table 1 presents sample characteristics. Complex sampling design was accounted for by computing robust standard errors using a sandwich estimator [35], and results were weighted to represent the 2001 birth cohort.

Table 1 Weighted distribution of maternal alcohol use before, during and after pregnancy and covariates (N = 9100)

Maternal alcohol use	Model estimated	Covariates	
<i>3 months before pregnancy</i>		<i>Age</i>	
No alcohol use	60.5 %	18–25	35.9 %
<1 drink/week	16.1 %	26–35	50.4 %
1–3 drinks/week	16.5 %	36+	13.7 %
4+ drinks/week	6.9 %	<i>Race</i>	
<i>Last 3 months of pregnancy</i>		White	60.0 %
No alcohol use	96.7 %	Black	13.7 %
<1 drink a week	2.1 %	Hispanic	20.4 %
1–3 drinks a week	1.1 %	Others	5.9 %
4 or more drinks a week	0.1 %	<i>Marital status</i>	
<i>9 month post- partum</i>		Married or cohabitating	82.0 %
No alcohol use	63.5 %	Others	18.0 %
Less than 1 drink a week	19.7 %	<i>Education</i>	
1–3 drinks a week	13.1 %	Less than high school	16.4 %
4 or more drinks a week	3.7 %	High school degree	28.8 %
<i>2 years post- partum</i>		Some college	29.2 %
No alcohol use	69.0 %	College or graduate school	25.6 %
<1 drink a week	15.4 %	<i>Employment</i>	
1–3 drinks a week	11.1 %	Not employed	46.6 %
4 or more drinks a week	4.5 %	Part time employed	20.5 %
<i>Child in preschool</i>		Full time employed	32.9 %
No alcohol use	64.4 %	<i>Household income</i>	
<1 drink a week	14.4 %	Lower than poverty line	22.5 %
1–3 drinks a week	14.8 %	100–130 % poverty line	11.4 %
4 or more drinks a week	6.4 %	130–185 % poverty line	12.3 %
<i>Child in kindergarten</i>		Above 185 % poverty line	53.8 %
No alcohol use	65.3 %	<i>Postpartum depression</i>	
<1 drink a week	13.2 %	Moderately/severely depressed	16.5 %
1–3 drinks a week	14.4 %	<i>Postpartum smoking</i>	
4 or more drinks a week	7.1 %	Smoked	20.0 %
		<i>Breastfeeding length</i>	
		Never breastfed	30.6 %
		Breastfed ≤ 6 months	42.6 %
		Breastfed > 6 months	26.8 %

Measures

Longitudinal Measures of Maternal Perinatal Drinking

For women who reported current alcohol use, quantity of use was assessed in preset categories of the number of drinks consumed in an average week (*less than 1, 1–3, 4–6, 7–13, 14–19, and 20 or more drinks*). Following Brown et al. [36] using the same dataset, we collapsed the original measures into a four-level variable (no alcohol, <1 drink per week, 1–3 drinks per week, and 4 + drinks per week) to maintain an ordinal scale while managing the low response frequencies in the higher use categories that pose

problems for model estimation (Across all measurement occasions, 0.1–7.1 % of mothers drank 4 + drinks and <0.1 % drank 7 + drinks per week.). Self-reported measures of alcohol use are considered reliable and valid, with contextual limitations [37].

Exogenous Variables

The following information was collected at baseline: *maternal age* (18–25, 26–35, and 36+), *education* (<high school, high school degree, some college, college/graduate school); *race/ethnicity* (white, black, Hispanic, other); *postpartum depression* measured with a modified 12-item

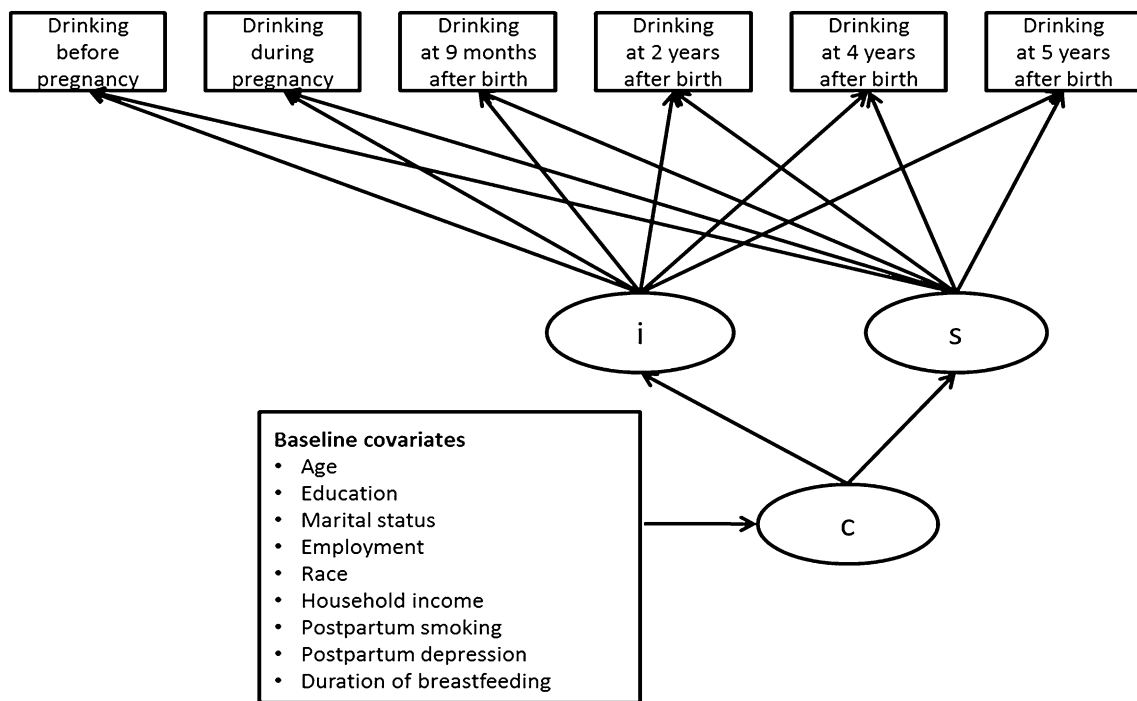


Fig. 1 Analytical model

version of the Center for Epidemiologic Studies Depression Scale (CES-D) [38] and recoded into severe/moderate depression and low/no depression per Paulson et al. [39]; mother’s *marital status* (married/cohabitating, other); *household income-poverty* (<poverty line, 100–130 % of poverty line, 130–185 % of poverty line, ≥185 % of poverty line); and *employment* status (full-time, part-time, not employed). Additional covariates include *duration of breast-feeding* (never, breastfed ≤ 6 months, breastfed > 6 months per Ogbuanu et al. [40]), as well as a binary current *maternal smoking* measure at baseline.

Analytic Plan

The multilevel nature of the data, i.e., measurement occasions nested within individuals, requires methods to arrive at unbiased point estimates and standard errors. While several methods are available to analyze such data, only General Growth Mixture Models (GGMM) [41] allow for inspecting inter-individual differences in intra-individual change. GGMM uses a categorical latent class variable in combination with continuous latent growth factors (see Fig. 1) to explore population heterogeneity in the change process of the outcome of interest, i.e., whether the study population consists of two or more discrete classes of individuals with varying growth trajectories [41, 42].

The modeling sequence followed the guidelines for growth models with ordered categorical outcomes [42, 43].

The specification of the latent growth model with categorical outcomes uses a latent response variable formulation [43] which assumes that a continuous latent response variable y^* underlies the observed response y with different thresholds delineating response categories. Growth factors (e.g. intercept and slope) are estimated representing the relationship between time and y^* . However, instead of residual variances for each growth indicator as is the case for conventional growth models, thresholds for each growth indicator are estimated [43].

The origin of time was set at the baseline interview in order to support the association of baseline covariates with subsequent drinking measures [44]. In order to test the overall functional form of the sample, we first estimated a series of growth models with fixed or random growth factors including intercept, linear and quadratic slopes. Model comparison and selection was based on theoretical reasoning and model fit [43] utilizing the Pearson model Chi-squared goodness-of-fit test, relative goodness-of-fit based on the likelihood ratio test (LRT) for nested models, and response pattern goodness-of-fit based on standardized residuals. A model with a random intercept and a random slope best described the development of maternal alcohol use during the study period.

Based on this functional form, heterogeneity in the longitudinal development of maternal drinking was explored by estimating models with increasing numbers of classes. Deciding on the number of longitudinal latent

classes is based on substantive evaluation of the classes as well as fit statistics for non-nested models, such as the Bayesian Information Criterion (BIC) and the Lo-Mendell-Rubin likelihood ratio test (LMR-LRT; a significant p value indicates that the model with $K-1$ number of classes can be rejected in favor of the model with K number of classes) [45]. Entropy (ranges from 0 to 1 and indicates a better classification of individuals as values approach 1), was obtained as a measure of classification quality, [46].

Upon finalizing class enumeration, we re-estimated the preferred GGMM model and simultaneously regressed the latent classes on exogenous variables via multinomial logistic regression equations [47]. All covariates were included simultaneously in a multivariate model, and the odds ratio for each covariate, adjusting for the effects of other covariates, is reported. Five hundred random start values were used to reach a global, rather than local, maximum [48]. All analyses were conducted using Mplus version 7.11 [49].

Results

Observed and Estimated Patterns of Drinking

Over half of the women (60.5 %) did not drink any alcohol pre-conception (Table 1). Among those who drank, most drank 1-3 drinks and only 6.9 % drank 4 + drinks per week. The majority (96.7 %) did not consume alcohol during their last trimester of pregnancy. The prevalence of drinking <1 drinks and that of drinking 1–3 drinks weekly

re-approached (though never fully returned to) preconception levels by the 9-month interview and remained relatively stable thereafter, while the proportion of women drinking 4 + drinks per week increased gradually to a level slightly higher than preconception. The estimated proportions from the selected functional form closely resembled the observed pattern, indicating good fit.

Heterogeneity in the Drinking Patterns

A four-class model ($LL = -34,513.0$ (16), $BIC = 69,171.83$) was selected (Table 2). Mothers in this sample were likely to fall into one of four alcohol consumption patterns (Fig. 2). Half of mothers (*Low Probability Drinkers*) were characterized by a very low and stable probability (<0.1) of any drinking. Nearly all mothers reduced or quit alcohol consumption by the third trimester of pregnancy. An *Escalating Risk Drinkers* group (12 % of the sample) exhibits a high and significantly increasing probability of drinking at different levels. With the exception of having a lower probability during pregnancy (0.3), mothers in this class had a 0.9 probability of drinking any alcohol (including < 1, 1–3 and 4 + drinks per week) throughout the study period. Mothers in this profile had a probability as high as 0.4 to drink 4 + drinks per week by the time their child entered kindergarten. One-third (27.4 %) of the recent mothers exhibited a low risk pattern of significantly escalating drinking (the *Escalating Low Risk Drinkers*) during the early parenting years. One in ten (10.2 %) mothers (the *Early Parenting Quitters*) who consumed at a level similar to the *Escalating Risk Drinkers*

Table 2 Determining the number of classes in GGMM (N = 9100)

Model	LL ^a	No. of parameters	BIC ^b	VLMR-LRT ^c P value	Entropy
1 class	-41,450.5	7	82,964.7	NA	–
2 class	-35,882.4	10	71,855.97	<0.001	0.818
3 class	-34,732.3	13	69,583.09	<0.001	0.781
4 class	-34,513.0	16	69,171.83	<0.001	0.751
5 class	-34,309.4	19	68,792.01	<0.001	0.728
6 class	-34,231.3	22	68,663.11	<0.001	0.721
7 class	-34,167.3	25	68,562.47	<0.001	0.735
8 class	-34,142.3	28	68,539.85	<0.001	0.735
9 class	-34,130.7	31	68,544.02	<0.001	0.736

While the 8-class solution presents the lowest BIC, the reduction in BIC from a 3 to a 4-class solution (411.3) or from a 4 to a 5-class solution (379.8) is considerably greater than that from 5 to 6-class (128.9), from 6 to 7-class (100.64), or from 7 to 8-class (22.62) solutions, indicating diminishing returns for estimating additional parameters. We thus further explored both 4 and 5-class solutions as candidate models. We ultimately decided on the more stable 4-class solution based on the following reasons. The “Escalating Risk Drinkers” class in the 4-class solution split into two classes in the 5-class solution (Escalating Risk Drinkers and a very similar class with a slightly different profile). Further, the cross-tabulation between membership of the 4-class and 5-class solutions shows one-third of the members in the Escalating Risk Drinkers class became members of the additional class in the 5 class solution. Graphs and results are available upon request

^a Log Likelihood; ^b Bayesian Information Criterion; ^c Lo-Mendell-Rubin likelihood ratio Chi-square test

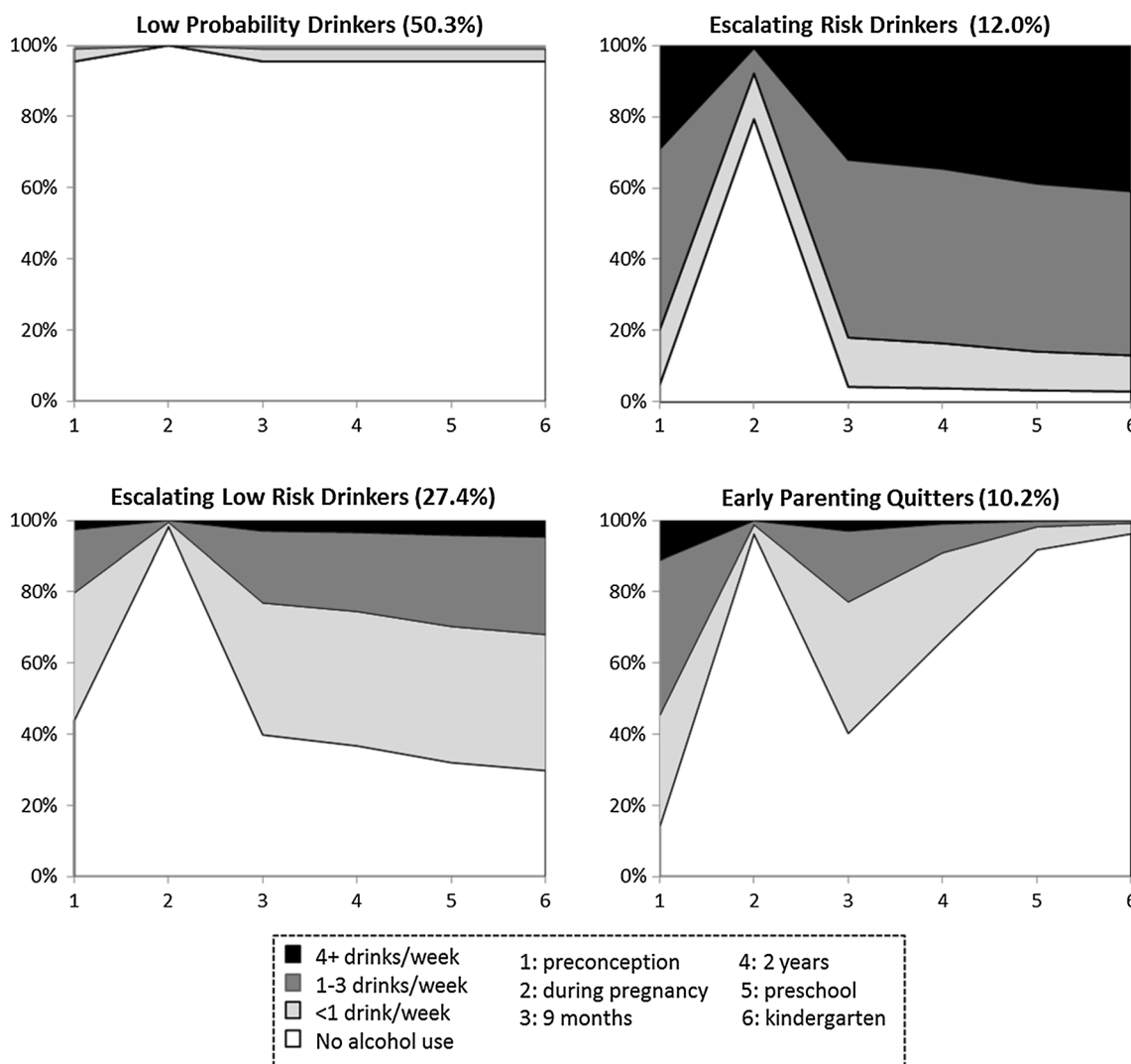


Fig. 2 Conditional 4 class solution

prior to pregnancy resumed consumption briefly postpartum but then exhibited a significantly decreasing trend, essentially having quit drinking when their child entered kindergarten.

Covariate Effects

Table 3 presents the effect of covariates on the log odds of being in one of the three drinking classes using *Low Probability Drinkers (LPD)* class as the reference group. Adjusted odds ratios (AOR) and significance level are presented, with an AOR >1 indicating increasing log odds of being assigned to a given class compared to the *LPD* class [50]. When compared to their peers who gave birth between ages 26 and 35, mothers younger than 25 were half as likely (AOR = 0.53) and those who gave birth when older than 36 were twice as likely (AOR = 2.18) to be in the *Escalating Risk Drinkers* class (vs the *LPD* class). Age

did not significantly influence profile membership for the other two drinking classes. Non-white mothers were less likely (AORs range from 0.26 to 0.57) and mothers with higher level of education were more likely (AORs range from 1.99 to 4.52) to be in either the *Escalating Risk Drinkers* class or the *Escalating Low Risk Drinkers* class versus the *LPD* class, when compared respectively to mothers of white race and those with less than high school education. No significant relationship was detected for race or education between the probabilities of being classified as an *Early Parenting Quitter* versus the *LPD* class.

When compared to those who earned an income below the poverty line, reporting a household income higher than 185 % of the poverty line significantly increased the probability of being in each of the three drinking classes (AORs range from 2.16 to 3.96) versus the *LPD* class, with the strongest effect being observed for the *Escalating Risk Drinkers*, Married or cohabitating mothers were less likely

Table 3 Multivariate model of maternal characteristics as predictors of three maternal drinking patterns (*Low Probability Drinkers* class as the reference class; N = 9100)

	Escalating Risk Drinkers (12.0 %)		Escalating Low Risk Drinkers (27.4 %)		Early Parenting Quitters (10.2 %)	
	AOR ^a	P value	AOR	P value	AOR	P value
<i>Maternal age</i>						
Age 18–25	0.53	0.002	1.05	0.685	1.08	0.695
Age 36+	2.18	<0.001	1.02	0.890	1.33	0.271
<i>Maternal race</i>						
Black	0.5	0.001	0.57	<0.001	0.72	0.178
Hispanic	0.26	<0.001	0.31	<0.001	1.1	0.561
Other	0.32	<0.001	0.45	<0.001	0.75	0.199
<i>Maternal education</i>						
High school	2.24	0.001	1.99	0.001	0.83	0.332
Some college	2.24	0.001	2.9	<0.001	1.18	0.427
College or grad school	4.52	<0.001	3.57	<0.001	0.73	0.330
<i>Household income</i>						
Income 100–130	1.03	0.890	0.95	0.755	0.75	0.213
Income 130–185	1.24	0.428	1.23	0.190	0.96	0.873
Income 185+	3.96	<0.001	2.57	<0.001	2.16	0.001
<i>Maternal marital status</i>						
Being married or cohabitating	0.62	0.002	0.63	0.001	0.56	0.004
<i>Maternal employment status</i>						
Part time employed	1.76	<0.001	1.43	0.005	1.39	0.103
Full time employed	1.2	0.196	1.48	<0.001	0.99	0.930
<i>Postpartum smoking</i>						
Smoking	4.31	<0.001	2.08	<0.001	3.84	<0.001
<i>Postpartum depression</i>						
Moderately or severely depressed	1.07	0.686	1.03	0.818	1.82	<0.001
<i>Breastfeeding</i>						
Breastfeed ≤ 6 months	1.68	<0.001	1.42	0.001	1.01	0.967
Breastfeed > 6 months	1.28	0.114	1.18	0.172	0.66	0.065

The reference category for *age* is 26–35; for *education* is <high school; for *race* is white; for *income* is <poverty line; for *marital status* is other; for *employment* is not employed; for *smoking* is not smoking; for *depression* is no depression; for *breastfeeding* is never

^a Adjusted odds ratio

to be in one of the drinking classes (*AOR* ranges from 0.56 to 0.63) versus the *LPD* class, compared to their single or divorced peers. While both part-time (*AOR* = 1.43) and full-time (*AOR* = 1.48) employment increased the likelihood of being in the *Escalating Low Risk Drinker* profile, only part-time employment increased the likelihood of being assigned to the *Escalating Risk Drinkers* class (*AOR* = 1.76), versus the *LPD* class.

Smoking postpartum increased the likelihood of being in each of the three drinking classes versus the *LPD* class with varying magnitude (*AORs* range from 2.08 to 4.31). Postpartum depression had a significant impact on being classified as an *Early Parenting Quitter* (*AOR* = 1.82) versus the *LPD* class, while the impact of depression on the other two drinking classes was not statistically significant.

Breastfeeding fewer than 6 months increased the probability of being an *Escalating Risk Drinker* (*AOR* = 1.68) or an *Escalating Low Risk Drinkers* (*AOR* = 1.42) versus the *LPD* class, while breastfeeding longer than 6 months did not have any significant effect on patterns of maternal drinking.

Discussion

Despite the growing body of literature on maternal alcohol consumption during pregnancy, this study is the first effort to investigate perinatal alcohol use as a longitudinal developmental process from preconception through the close-knit early parenting years. The simultaneous

examination of inter-individual variation in intra-individual change is crucial to the identification of *what*, *whom* and *when* to target for prevention interventions aiming to reduce the harmful effect of maternal drinking on maternal and child health. While the literature has consistently reported on the general trend of maternal drinking resuming postpartum, results from this GGMM analysis indicate a great degree of heterogeneity in these longitudinal patterns. Specifically, from preconception until the child enters kindergarten, mothers in our sample were likely to fall into one of four alcohol consumption patterns characterized by different baseline levels of alcohol consumption and changes over time.

While the *Escalating Risk Drinking* class does not necessarily signal risky drinking as judged by federal standards for women (i.e. 7 + per, per the National Institute on Alcohol Abuse and Alcoholism), the consistent tendency of drinking 4 + drinks per week (with the potential for occasional binge drinking) during this critical period of time is concerning. About one-third of the women in this group continued drinking during pregnancy. According to CDC and the US Surgeon General, no amount of alcohol consumption has been proven safe during pregnancy [51, 52]. Further, excessive postnatal alcohol consumption may pose risks to children [12].

Consistent with other research regarding risk factors for maternal drinking [7, 9, 26, 53, 54], white race, older age, greater income, higher education, being single, and part-time employment are associated with following the *Escalating Risk Drinking* pattern. Although depressive symptoms are commonly associated with AUDP [21, 53, 55], evidence regarding the association between postpartum depression and longitudinal patterns of alcohol consumption tend to be mixed. Consistent with a study of risky drinking [9], in the present study, postpartum depression did not differentiate escalating drinking patterns from *Low Probability Drinkers*, whereas other research has found correlations between postpartum alcohol use and depression [56]. However, past studies measured postpartum alcohol use at a single time point and thus were not designed to differentiate the effect of depression on distinct longitudinal patterns of maternal alcohol use.

The finding that smoking postpartum increased the likelihood of mothers following one of the three drinking trajectories (vs the *LPD* trajectory), is consistent with past studies associating smoking with the risk of drinking [4, 55, 57]. This finding emphasizes the value of guidance for clinical screening of maternal smoking behavior throughout the early parenting years (i.e. in pediatric settings as well as maternal clinical visits) to address alcohol use as well.

The positive association of breastfeeding for <6 months with *Escalating Risk* and *Escalating Low Risk* drinking is

consistent with studies finding that increased postpartum drinking is associated with breastfeeding for shorter time periods [11]. New mothers may be inclined to make healthier choices through the breastfeeding period out of concern for their child's health [58]. Postnatal maternal health care and pediatric visits may support women maintaining reduced alcohol consumption for longer by encouraging breastfeeding for at least 6 months, thus reducing the risks to child development associated with maternal drinking [59, 60].

Limitations include: First, the baseline measurement of depression reported an average of 9 months post-delivery does not include any detail about constancy or intensity. Second, although personal characteristics correlated with drinking *frequency* may vary [20], this study is limited to measures of weekly drinking *quantity*. Research incorporating longitudinal measures of both quantity and frequency will further elucidate women's drinking patterns in this critical period of their reproductive lives. Last, while 4 + drinks per week does not necessarily signal risky alcohol consumption outside of pregnancy, there are multiple reasons to attend to such drinking pattern during this period of their lives. Despite the biological risks associated with any drinking during breastfeeding, 4 + drinks per week may also signal for some women the potential of binge drinking which poses threats to women's health and child wellbeing.

It is concerning that despite a decline in drinking prevalence rates among pregnant women from the 1980s through the early 2000s [61, 62], this rate has stabilized in the past decade [63]. The prevalence of alcohol consumption among recent mothers within a year postpartum also remains high [63]. The potential risks that excessive maternal drinking cast on maternal and newborn health during this critical period of time call for prevention and intervention effort outside of the commonly targeted 9-month pregnancy period.

Though literature suggests some evidence for effectiveness of several interventions (e.g. motivational interviewing, brief interventions, cognitive behavioral therapy, and health education) on drinking abstinence during pregnancy [64], a review of postpartum home visits did not find any evidence of effectiveness in reducing alcohol misuse [14]. Thus, expanding prevention of AUDP and maternal alcohol misuse during early parenting years may require redesigning the approach and expanding the target population to women of reproductive age. Although most women (87 %) who report consuming alcohol before they realized they were pregnant report abstaining completely by the time of their first prenatal visit [55], as many as one-third of women of reproductive age may be classified as risky drinkers [65]. An experiment targeting women of reproductive age with two 15-min scripted sessions

resulted not only in significant reductions in past week drinking and binge drinking episodes, but also showed positive impact for participants who got pregnant within the 48-month follow up period [66]. In addition, existing and new prevention strategies should take this research into account to tackle postpartum and early parenthood alcohol consumption whether through enhancing social support systems or promoting healthy stress management associated with increased responsibilities of caring for a young child. Findings of different patterns of maternal perinatal drinking associated with maternal characteristics provide potentially valuable tools for family physicians, pediatricians and nurse practitioners to identify those at risk for problem drinking during this critical time period and to better tailor interventions to individual needs.

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